An Evaluation of Degradation, Movement, and Fate of Polyacrylamide (PAM) in the Environment

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Polyacrylamide (PAM) has been sold in the U.S. since 1995 for use as a soil amendment. It has both soil stabilizing and flocculating properties, controls soil erosion, and improves the soil's water-holding capacity. It substantially improves runoff water quality by reducing sediments, nitrogen, phosphorus, chemical oxygen demand (COD), pesticides, weed seeds, and microorganisms. An ecological model has been developed to understand the mechanism of degradation, movement, and the ultimate fate of PAM in environment. PAM in soil systems has been reported to decompose as a result of physical, chemical, biological, and photochemical processes and reactions. PAM degrades to an acrylamide monomer via a free radical process initiated by sunlight by breaking carbon-carbon bonds. Acrylamide is hydrolyzed in soils, producing NH_4^+. The NH_4^+ produced, is oxidized to NO_2 and NO_3 under aerobic condition and accumulates as NH_4^+ under waterlogged conditions. A wide variety of microbes possess the ability to degrade acrylamide under light or dark, anaerobic or aerobic conditions. Direct measurement of acrylamide monomers or carbon dioxide/ammonia and their ecological consequences in the agro/aquatic environment has not been evaluated. PAMs are water soluble and capable of moving through different soil type under various conditions. Most of the acrylamide released to the environment is expected to end up in water. PAM has many safety and environmental concerns. Acrylamide monomers are potential groundwater contaminants and toxic to human, animal, and plant life. There are several reports of short and long term exposure, subacute and acute toxicity, subchronic and chronic toxicity, mutagenecity and carcinogenecity, reproductive disorders, and pharmaookinetic effects of acrylamide on human and animal health. Since PAM is not covered under FIFRA, it is not regulated. Section 303 (c) of Clean Water Act requires states and tribes to adopt criteria necessary to protect designated uses and where those uses may be adversely affected by the presence of a pollutant. In Colorado there is a project to seal irrigation canals by using PAM. Bureau of Soil Reclamation and other agencies have asked Region 8 whether PAM (a harmful substance after degradation) application is appropriate to reduce the Selenium pollution. The use of PAM application has been increasing year after year in farms and other places. A research pilot is needed to evaluate the PAM-impaired agro/aquatic system.